



2012 International Conference on Solid State Devices and Materials Science

A Multi-Agent approach To the Design of An Programming ICAI System

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Abstract

Programming ICAI covers the whole range of teaching and learning of programming, multi-agent approach is suitable for the development of ICAI program. In this paper ,Firstly the design goal and ideas are described for the Programming ICAI. Secondly multi-Agent approach is introduced for developing Programming ICAI and the design of agent and the design of multi-agent structure are presented for Programming ICAI System. Finally interaction of multi-agent is presented , enabling the system to teaching and testing according to the student's aptitude.

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Keywords: software agent , PAR method, multi-agents, KQML

1. Introduction

Nowadays, lack of Software talents has repressed the development of IT industry, and training of Software talents has become a hot topic in the new century. As a result, how to train software talents becomes a focus of experts around the world. As a brand-new computer Aided Instruction, it has been employed by a lot of research institutions and companies to train software talents.

Currently most systems of PICA (Programming Intelligent Computer Aided Instruction) take advantage of Sensory stimulation with multi-media and the systematic design is guided by stimulation – reflection theory. With the development of cognitive psychology, constructivism is becoming the foundation of ICAI. However, the design work of the System requires the higher requirements if Constructivism is integrated into the system.

Agent is a kind of self-learning software entities adapted to the environment. Intelligent agents are software entities that carry out a set of operations on behalf of a user or another program with some degree of independence or autonomy, and in so doing, employ knowledge or a representation of the user's goals or desires[1]. They have been used in domains that require cooperation, negotiation, learning, planning, and knowledge sharing characteristics [2].

Multiagent systems (MAS) [3,4] are a very active field to handle the dynamism in the environment as it offers modularity and flexibility, and characteristics that are essential in complex, large, distributed, and unpredictable domains[5]. As the agents in MAS are specialized at solving a particular problem, they offer modularity to a complex system[6,7]. Development of Agent provides a new way of thinking and solutions for PICAL.

This paper presents a multi-agent model of PICAL based on PAR Method, and then gives a picture of how to apply a multi-agent model to PICAL aiming at teaching Par Method[8], based on the model using JATLite Agent Platform of Stanford University.

The paper is organized as follows. Section 1 is a brief introduction and Section 2 contains the idea and goal of PICAL. A multi-agent model of PICAL is contained in Section 3 and agents of proposed multi-agent system are elaborated in Section 4. Interaction of agents are contained in Section 5. Section 6 presents possible future work.

2. Design of pical

The main task of constructing PICAL is to make it possible that common computer users are able to master general computer applications and practical programming techniques as a basis for a variety of PICAL, together with in-depth research and study of scientific principles and methods about Programming and to distinguish the relationship between computer language, programming methods and procedures and design capability. Another main task is to make the theoretical and experimental results obtained from domestic and international research in programming methodology applied timely in programming practice of high-level programming language[9]. Professor Xue Jinyun proposed PAR method, a new programming model for intelligent CAI environment, into teaching content.

Based on the model, PICAL teaches the PAR methods in a way of merging teaching strategies into the Agent in order to enable the teachers with certain knowledge of Artificial Intelligent and the learners to self-learn, self-practice and self-test Par methods.

Overall system design is described as below :

1. The construction of knowledge database system follows the principle of "knowledge as the center point". Elementary knowledge of the PAR method and knowledge of PAR method are divided into independent knowledge point, connecting certain knowledge point with its explanations, exercises, and test examples. What's more, in order to help users to practice more, it will help build knowledge points Case library to provide adequate prompt information and analyze the test results in order to figure out why errors committed as well.

2. To meet different demands, the System is divided into four different teaching environments for different levels of students.

Basic knowledge environment: In this environment, students can learn preliminary knowledge of the PAR method including construction and transformation of programming specification and consolidate the knowledge through practice. Necessary prompts are given. If they pass the test, they can continue the next level environment.

Simple Programming: In this environment, students learn PAR method and develop simple algorithms based on PAR method. The learners can practice a simple algorithm to consolidate the process about how to develop program with the help of PAR. Necessary prompts are given. Moreover, it can help

correct errors if the users input a piece of wrong information. If they pass the test, they can continue the next level environment.

Typical programming: In this environment, learners practice a typical algorithm to consolidate development process of the program with the help of PAR. Necessary prompts are given. Moreover, it can help correct errors if the users input a piece of wrong information. If they pass the test, they can continue the next level environment.

Sophisticated programming: In this environment, learners mainly learn to develop complex algorithms with the help of PAR method, including tree, graph algorithms; and algorithm development environment is provided with the PAR method, a certain degree of help provided.

3. The teaching strategies are integrated into the interaction of Agents, and appropriate learning environments are generated for students. Through the interaction of multi-agent, teaching strategies are implemented.

4. The system is set up based on the model using JATLite Agent Platform of Stanford University, a means of fast construction, providing the most basic support of communication between Agents.

5. During the implementation process, the system would make use of multi-media to strengthen what the learners have learnt, including video insertion; audio insertion is also employed to arise the users' interest.

3. Multiagent Model of Picai

Based on a new programming environment for intelligent CAI model proposed by Professor Xue Jinyun in [9], this paper presents a multi-Agent Model of PICAI which aims to provide students individualized learning platform, teachers and students Test platform according to their level and ability and a platform for teachers to manage Knowledge Base.

The model is as follows:

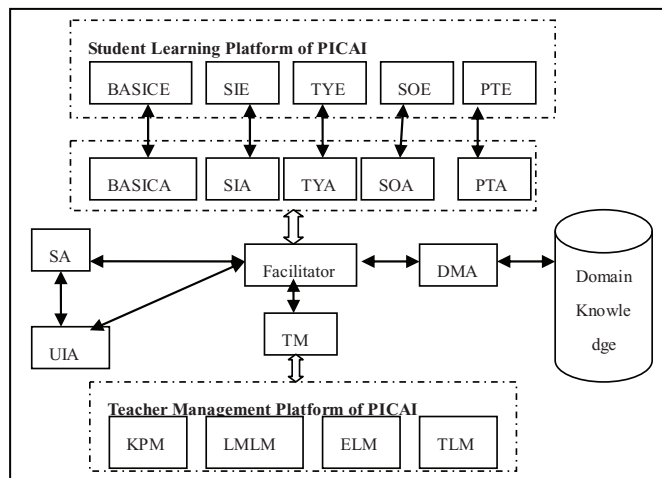


Fig. 1. MULTIAGENT MODEL OF PICAI

PICAI mainly consists of Student Learning Platform and Teacher Management Platform.

Student Learning Platform consists of five Environments: BASICE(Basic knowledge Learning Environment) 、SIE(Simple program Learning Environment) 、TYE(Typical Program Learning Environment) 、SOE(Sophisticated program Learning Environment) 、PTE(Professional Test Learning Environment) .

Teacher Management Platform consists of four modules: KPM(Knowledge Point Management) 、LMLM(Learning Material Library Management) 、ELM(Example Library Management) 、TLM(Test Library Management) 。

The following agents exist in the System: UIA(User Interface Agent) 、SA(Student Agent) 、BASICA(Basic Knowledge Teacher Agent) 、SIA(Simple Program Teacher Agent) 、TYA(Typical Program Teacher Agent) 、SOA(Sophisticated Program Teacher Agent) 、DMA(Database Management Agent) 、PTA(Professional Test Agent) 、TMA(Teacher Management Agent).

Figure 1, the execution process is as follows: student or teacher sends the request (lectures, review, Q & A or test) directly to the facilitator by UIA based on human-computer interface. Facilitator receives orders through the automated reasoning to determine the corresponding teaching strategies and generate the corresponding learning environment.

4. Design of Agents

The following is the design of agents :

UIA perceives user's action through GUI and interacts with appropriate agent using KQML message, UIA transfers messages with various teacher agents of Learning Environment, and TMA to merge teaching strategy into system.

SA mainly saves some student's information including learning process, every learner's learning pace, relevant knowledge points, and passes these information to other agents. As study goes further, it will change the relevant information accordingly at the same time and keep a record of the learner's study, and then the user can continue their study conveniently.

According to different students' learning process, facilitator will assign specific teaching agent for each learner as a guidance, and switch to different agent when necessary, ensuring it takes place in an appropriate environment.

BASEA 、SIA 、TYA 、SOA are respectively responsible for Basic knowledge, Simple program, Typical Program and Sophisticated program learning environment, and each learning environment will apply teaching strategy and guide students to learn programming.

PTA creates all kinds of practice, test environments for users, facilitating students to consolidate learning knowledge and make their own teaching plan according to the received feedback.

DMA is able to accept KQML messages from other Agent, and convert KQML messages into corresponding SQL operation, including database connections, query, insert, delete, modify and guarantee the security of database accessing.

The above is a brief introduction of related Agent. However, each Agent doesn't finish the task alone, but through interaction and cooperation among agents, and during the interactive process, modern education ideas like "Teaching students according to their aptitude" are implemented and the system is intelligent in a certain aspect.

5. Interaction of Agents –Test Request

In multi-Agent System, each agent needs to work cooperatively; therefore a specification to unify the communication of Agent is required. Many foreign experts put forward some communication standard, among which KQML(Knowledge Query and Manipulation Language) is considered as the most mature.

KQML is a language and protocol for exchanging information and knowledge. It is part of a larger effort, the ARPA Knowledge Sharing Effort, which provides standard format to support real time communication of agents and can be used as a language for an application program to interact with an

intelligent system or for two or more intelligent systems to share knowledge in support of cooperative problem solving [10].

KQML focuses on an extensible set of performatives, which defines permissible operations that agents may attempt on each other's knowledge and goal stores. Based on Speech Act Theory, performatives provides norms for each agent and the performatives comprise a substrate on which to develop higher-level models of inter-agent interaction such as contract nets and negotiation.[10]

A KQML message is also called a performative, an ASCII string using the syntax defined by this section.

The organization of teaching process is implemented through the interaction of agents. According to the system's actual requirement, KQML performatives are expanded and develop a customized multi-agent interaction protocol, which can be divided into two parts:

5.1 KQML Standard Performatives

Register and Connect are used to register and connect to AMR ;

5.2 KQML Performatives

Interaction of Agents in the PICA is achieved in three aspects: Student Login, Test Request and Request Senior Course. The next is an example to illustrate the cooperation between multi-agent in detail: when the user asks for Test, facilitator agent determine whether to allow testing according to the user's level..

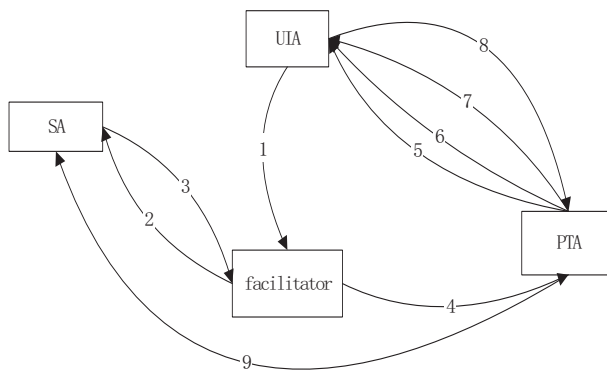


Fig.2. Test Request

- 1.(:perf test :content()) Sender UIA Receiver facilitator
- 2.(:perf Get_SA :content()) Sender facilitator Receiver SA
- 3.(:perf Send_SA :content(level))Sender SA Receiver facilitator
- 4.(:perf request_test :content(level))Sender facilitator Receiver PTA
- 5.(:perf Begin_b_test :content()) Sender PTA Receiver UIA
- 6.(:perf Begin_s_test :content()) Sender PTA Receiver UIA
- 7.(:perf Begin_t_test :content()) Sender PTA Receiver UIA
- 8.(:perf Result :content(level)) Sender UIA Receiver PTA
- 9.(:perf Result :content(level)) Sender PTA Receiver SA

As illustrated in Figure 2,when the user sends Test Request, then UIA will send Test Request to facilitator who firstly acquire current level of SA, SA return his level back to facilitator, and then facilitator send test request to PTA with SA's level ,PTA generates different Testing Environment

according to SA's level. After Testing, facilitator decides whether to permit the advance to SA level according to the situation of answering.

6. Conclusion and Future Development s

The program design ICAI is a comprehensive subject involved in program design methodology, artificial intelligence, cognitive science, computer science, and pedagogy. This paper puts forward a Multi-Agent Model of PICA I, and according to it, PICA I can be realized. With teaching strategy in agents, the system can help teachers having some knowledge of artificial intelligence realizes the thought of the individualized learning, coach education. It also realizes the basic teaching students according to their aptitude and individualized teaching goal. Since the PCA I is a comprehensive and interdisciplinary subject, in the actual research many problems still exist. This system is on the prototype stage, and many places are waiting to be improved and perfected.

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